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USSR INVESTIGATION OF THE INFRARED RADIATION OF THE NIGHT SKY

The following lecture was given at the March 1952 session of the Department of Physicomathematical Sciences, Academy of Sciences USSR, by V. I. Krasovskiy, Doctor of Physicomathematical Sciences. A summary of the lecture and comments of others attending the session was published in Vestnik Akademii Nauk SSSR, No 4, April 1952, follows.

This report clarifies work carried out in 1948 - 1951 at the Crimean Astrophysical Institute, Academy of Sciences USSR.

In the daytime, at an altitude of about 100 km, short-wave solar radiation dissociates the molecules of the earth's atmosphere into atoms. Most easily disrupted by this radiation are molecular oxygen and, in a lesser measure, nitrogen. Also decomposed are molecules of water, hydrogen, and carbon dioxide. The decay process of molecules is compensated for on the average by the process of their formation from atoms. The reunion of atoms into molecules proceeds slowly and continues through the night, when the sun's short-wave radiation is absent. The molecules which reform are strongly excited and, therefore, very active chemically. Thus, there develop chains of multifarious chemical reactions between the excited molecules and the various elements of the earth's atmosphere. The loss of excitation by the reformed molecules and atoms is accompanied by radiation. The radiation which arises in this way is of comparatively small intensity and is observed with difficulty. In the daytime, this radiation is masked by scattered solar light and is amenable to investigation only at night; it is in this connection that this phenomenon has received the name "radiation of the night sky."

Until recently, only the spectra of night-sky radiation in the visible and ultraviolet regions of the spectrum had been known: they consisted of the weak bands and lines of oxygen and nitrogen molecules and atoms. Application of the electron-optical [image] converter essentially increased the sensitivity of spectral analysis and permitted us to investigate the infrared region of the spectrum up to 12,000 angstroms. Thus, we obtained radiations of the night sky that were completely unknown earlier in this region of the spectrum and which,

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as it turned out, are very complicated in structure. At present, this structure is still not fully clarified. However, the bands of hydroxyl and molecular hydrogen are sufficiently established. Possibly present are the spectra of nitrogen oxides and dioxides and also nitrogen hydride. The contours of the bands permit us to determine the temperature of the radiating layers. We observed the variation, in time, of the intensity of individual bands.

Most interesting, in the opinion of the lecturer, is the existence of hydroxyl bands, which testifies to the high concentration of hydrogen in the zone which radiate them. Since the presence of hydrogen is connected, in the final light, with the presence of water, it is obvious that the bands of hydroxyl testify to the humidity of the high layers of the earth's atmosphere.

In the concluding part of the lecture, it was emphasized that the investigation of night-sky radiation is a powerful means for establishing the composition and properties of the high layers of the earth's atmosphere and also for clarifying the processes occurring in them. Further accumulation of factual material and its final deciphering will ensure the solution of one of the most important problems of modern geophysics.

This lecture caused heated discussions. Those who participated unanimously acknowledged the high value of the work conducted, which is a decided success for Soviet science.

I. S. Shklovskiy, Doctor of Physicomathematical of Science, pointed out that the material communicated in the report possesses great value not only from the scientific viewpoint but also from the practical one. However, in the opinion of I. S. Shklovskiy, the excitation of hydroxyl is most effective in the ozonohydroxyl reaction which occurs at an altitude of 75 km.

Professor I. A. Khvostikov emphasized the tremendous significance of the new method of investigation and of the material data, obtained with the aid of the new method, on night-sky radiation. Khvostikov expressed certain remarks in connection with the hypotheses of V. I. Krasovskiy and I. S. Shklovskiy concerning the mechanism governing the excitation of night-sky radiation. However, these particular remarks, as I. A. Khvostikov pointed out, did not lessen the value of the work conducted.

Academician G. S. Landsberg said that the value of the new method and of the data obtained with its aid causes no doubts. However, the problems of theoretically handling the data must be verified by further consideration, which is done best of all at an all-Union conference on spectroscopy which is planned to be held in summer 1952.

In conclusion, V. I. Krasovskiy once more noted that, independently of this or any other outcome of the discussion concerning the hydroxyl-excitation mechanism, investigation of night-sky radiation is the key to the solution of important problem of physics of the upper layers of the earth's atmosphere.

In closing the session, B. M. Vul, Corresponding Member of Academy of Sciences USSR, indicated it is urgent that work on the investigation of night-sky radiation, in view of its great value, be continued for the purpose of obtaining the final results with greatest speed.

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